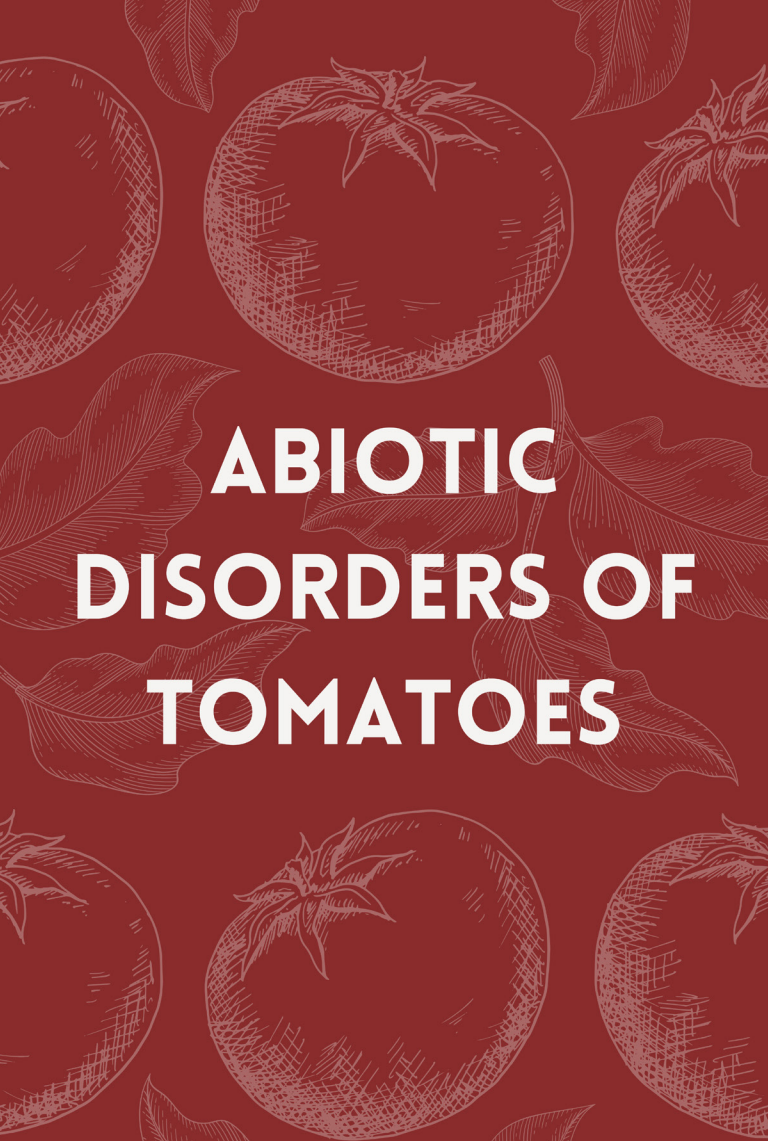
ABIOTIC DISORDERS OF TOMATOES



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Abiotic Disorders of Tomatoes

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Identifying Problems on Tomatoes

Monitoring tomato plants regularly from seedling to harvest allows for early detection of abnormal conditions. Although tomato plants can be attacked by a variety of living organisms (insects, mites, pathogens, vertebrates), nonliving (abiotic) conditions can cause just as much damage.

Abiotic diseases in tomato plants can arise from nutrient deficiencies, temperature extremes, abnormal lighting, chemical application, changes in water uptake, mechanical damage, genetic mutations, and more. This guide will cover most of the abiotic disorders and diseases that can affect tomatoes in Utah.

Your local USU Extension county office and the Utah Plant Pest Diagnostic Lab can work with you in identifying problems in tomato plants through image or sample submissions.

Extension offices: extension.usu.edu/locations
Lab: extension.usu.edu/pests/uppdl/

Key to Affected Plant Parts

Stem Roots Fruit Foliage

Key to Condition Severity

No effect on plant health or yield.

Moderate decline on plant health and yield.

Minimal decline in plant health and yeild.

Severe effect on plant health and yield.

Adventitous Root Growth

Description

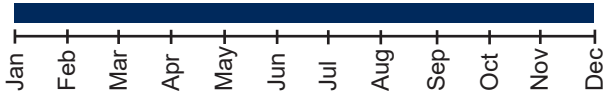
Tomatoes (especially heirloom varieties) and other solanaceous vegetables, such as tomatillos, can generate new roots from hairs found on the stem above the root system. These often present as short, fleshy bumps along the stem prior to root formation. These structures may appear harmul to the plant, but they are not. Adventitious roots have the potential to grow into roots if placed in contact with the soil, boosting the ability of the plant to take up water and minerals.

Management

Although adventitious root growth in the soil can help to support large, healthy plants, excess formation of nodules aboveground may be a sign of plant stress. Excess water is the most common cause, reducing oxygen availability to the root, and stimulating the plant to form aboveground root structures. When planting tomatoes, placing them deep into the soil or trench-planting so that a portion of the stem above the root system is in contact with the soil will promote adventitious root growth.

Timing

This condition can occur any time during production, outdoors or indoors.



Blossom Drop

Description

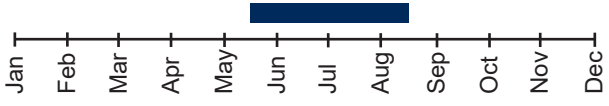
Flowers that dry and drop from stems with no fruit formation are primarily caused by temperatures that are not conducive to effective pollination. Blossom drop occurs when daytime temperatures above 90°F accompany nighttime temperatures above 72°F or below 55°F. Excessive heat desiccates pollen, resulting in poor fruit set and dried blossoms that eventually drop. Split set on tomatoes is a related issue and occurs when a period of intense heat surrounds pollination and fruit set. This results in two distinct crops of tomatoes, with a period between with little to no production.

Management

Tomatoes grow best in daytime temperatures between 72°F and 85°F. Shade cloth (30% shade) can help reduce the incidence of blossom drop by moderating temperatures around the plants. However, in extreme and prolonged heat, it is unlikely that the problem can be corrected until temperatures are reduced. Irrigation management and mulching at the base of the plant to keep the soil evenly moist and help pollen stay hydrated and viable. Other causes of blossom drop include wind, low humidity, and high nitrogen content, all of which promotes vegetative growth and limits blossom development.

Timing

Blossom drop is most common during months of extreme temperature (July and August in northern Utah).



Blossom-end Rot

Description

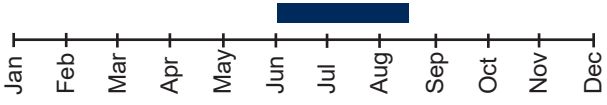
Blossom-end rot is a disorder caused by a lack of calcium in the fruit. Calcium is a nutrient that contributes to healthy cell walls, and when deficient, cell breakdown occurs, leaving the brown water-soaked or target-like spots on the bottom of the fruit. Blossom-end rot can occur on other crops, including summer squash, peppers, eggplant, and more. Causes of the disorder include uneven soil moisture, over-fertilization, or prolonged periods of cool, wet soil. The uneven or excess moisture prevents the delivery of calcium to the farthest reach of the plant—the blossom ends of the fruits.

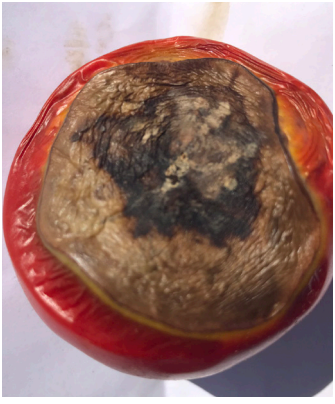
Management

Blossom-end rot can be prevented with proper irrigation management and mulch to maintain even soil moisture. Avoid overwatering as it can exacerbate the condition, especially in heavy clay soil. If blossom-end rot is a recurring problem, spray plants with a foliar calcium spray (available at garden centers). Applying calcium or eggshells to soil is ineffective as Utah soil typically has ample calcium levels. Remove affected fruit from plants to promote healthy development of remaining fruit.

Timing

Blossom-end rot is most common during periods of intense heat or when irrigation management is less than ideal. Look for damage from June through August.





Cat-Facing

Description

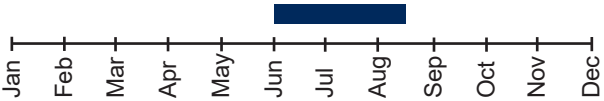
The term cat-facing refers to tomatoes that are generally distorted, misshapen, or dimpled. The damage usually results from injuries that cause the fruit's blossom scar to become enlarged or perforated. Causal factors include high nitrogen levels, temperature extremes or fluctuations during flowering, excessive pruning, or poor pollination. Feeding by piercing-sucking insects such as stink bugs or lygus bugs damage the tomato skin, also causing cat-facing symptoms.

Management

Growing conditions that best support plant growth and good pest management can reduce cat-facing. Floating row covers may reduce cat-facing if insects are causing the damage. Avoid excessive nitrogen, prune properly, and select cultivars that are less prone to cat-facing (some heirloom tomato varieties are more susceptible). Tomatoes with cat-facing are still edible but less likely to be marketable.

Timing

Cat-facing occurs when flowers are formed, and symptoms occur on fruit throughout the growing season.



Chimera

Description

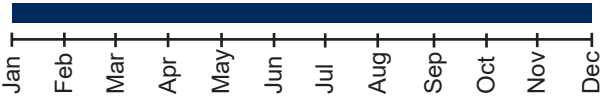
A chimera is a genetic mutation characterized by foliage with distinct yellow or white patches. It often occurs on leaf halves or is delineated by veins. This genetic abnormality occurs infrequently and spontaneously. A chimera can be mistaken as a virus infection symptom but is not pathogen-caused and is not a concern for plant health as it cannot spread to nearby plants.

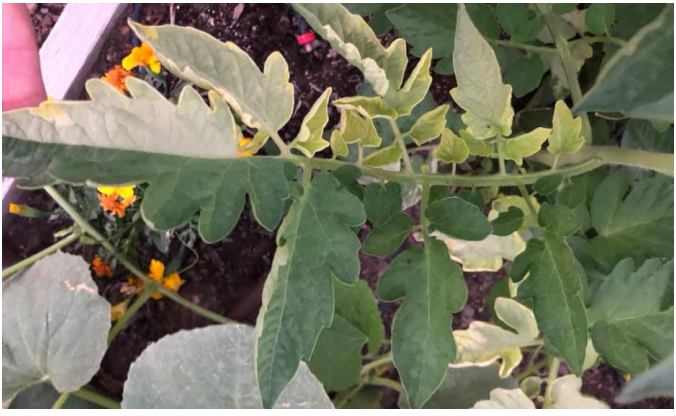
Management

There is no management recommended for chimera as it is harmless. Plant tissue that is white or yellow may be more prone to sunburn, and browning may occur where these patches exist. Plants with a chimera do not need to be removed and can be protected from excessive sun exposure with the addition of shade cloth (30% shade). Chimeras are generally limited to a few leaves or a shoot, and removing those plant parts will remove the chimera.

Timing

A chimera can occur at any time in the life of the tomato plant.





Cracking/Splitting

Description

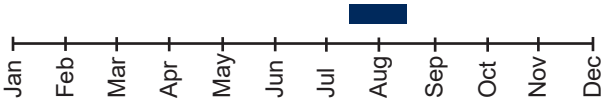
Cracking and splitting occur when rapid changes in soil moisture levels cause the fruit to expand faster than the epidermis (skin) allows. Cracking shows as vertical splits (radial cracking) or a circular pattern on the top of fruit (concentric cracking). Radial cracking is the most detrimental to fruit; however, both types reduce fruit quality by increasing susceptibility of fruit to insect-feeding and colonization of decay or rotting organisms.

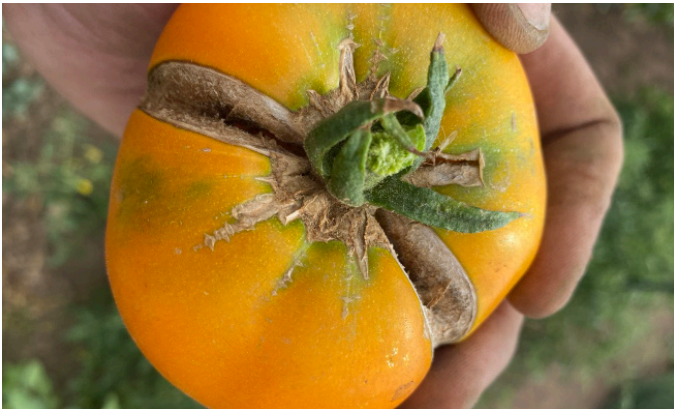
Management

Proper irrigation practices and mulching will provide even soil moisture and growth of fruit, which can prevent cracking. Some varieties are less prone to cracking, such as ‘Jetstar’, ‘Mountain Spring’, and ‘Mountain Fresh’. Unripe fruits that have cracked will likely rot if left on the vine. Tomatoes should be harvested and consumed or processed as soon as cracking occurs to reduce the introduction of rot.

Timing

Cracking can occur any time there is excess soil moisture but is most common during times with monsoonal rainstorms, such as late July and August.





Cold Injury

Description

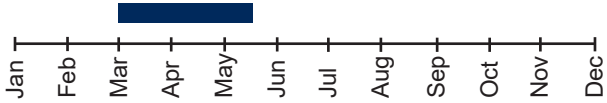
Cold injury occurs when tomato plants are exposed to temperatures between 33°F and 50°F. These temperatures, in combination with other environmental factors, can cause leaf tissue damage and reduced of flower formation and fruit production. Damaged leaf cells appear as interveinal brown spots on young plants, while leaves on established plants may turn dark purple. Although cold injury is not detrimental, plant growth can be stunted and actively growing fruit may be damaged under prolonged cold periods.

Management

To avoid injury, transplant tomatoes after the danger of frost has passed and when nighttime temperatures are consistently above 50°F. Follow weather forecasts closely in the spring and fall and cover plants for protection as needed. Low tunnel or floating row covers can be added to raise the ambient air temperature around the plant during cold nights. Remove row covers as temperatures rise during the day to reduce humidity and avoid extreme heat (over 90°F).

Timing

Cold injury can occur anytime the temperature drops between 33°F and 50°F but is most likely to occur in spring and fall.



Edema/Oedema

Description

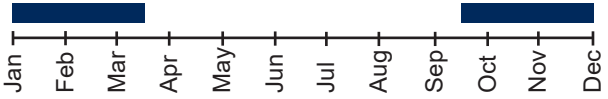
Edema (oedema) is identified by watery blisters (swellings) that form along the leaf veins and typically occur on the undersides of leaves. Under severe cases, edema can cause leaf drop, spindly stems, and eventually halt plant growth. Edema is induced by high relative humidity, overwatering, and/or low light quality, causing the plant to take up more water than it can transpire. Because of this, edema is most commonly observed in greenhouses during prolonged cloudy weather.

Management

To avoid edema, vent the greenhouse to reduce humidity and space plants apart to improve air flow and light penetration. Other methods include using of supplemental lighting during winter or prolonged overcast days and avoiding overwatering.

Timing

Edema most commonly occurs in late winter in greenhouse production or during prolonged cloudy and humid weather.



Freeze Damage

Description

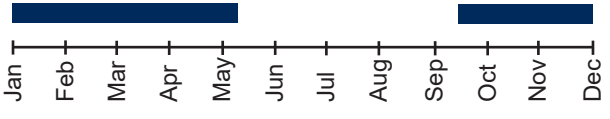
Freeze damage occurs when temperatures drop below 32°F, causing leaf, stem, and fruit tissue to freeze, expand, and rupture. Plants will not recover once significant freeze damage has occurred.

Management

Prevent damage by growing tomatoes in protective structures like a high tunnel or greenhouse. Low tunnels or floating row covers are inexpensive options that increase ambient temperature by roughly 3-5 degrees depending on the type and thickness of material. Covers should be supported to prevent the leaf tissues from freezing where they come into contact with the material. Covers should also be weighted down at the edges to prevent heat loss. Irrigating the day before temperatures drop can reduce damage since irrigated soils retain heat and release it at night.

Timing

Freeze damage typically occurs in spring and fall when temperatures drop below 32°F.



Green/Yellow Shoulder

Description

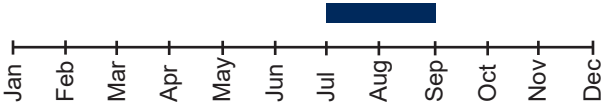
Green shoulder is a fruit ripening disorder that appears when tomato fruits have fully ripened, but the top “shoulder” of the fruit remains green and yellow. This discoloration can also appear inside the fruit and is not alleviated through extended ripening time. The green shoulder areas remain hard with an underdeveloped flavor. Green shoulder is partially caused by genetics, with some cultivars being more susceptible than others. It can also be caused by environmental conditions, including temperatures above 90°F or below 60°F, high humidity, and exposure to direct sunlight.

Management

Prevention includes selecting cultivars that are less susceptible and covering tomatoes with shade cloth of up to 30% to decrease light intensity and ambient temperature.

Timing

Green shoulder disorder occurs as the fruit is developing and becomes visible as the fruit begins to ripen.



Herbicide Damage

Description

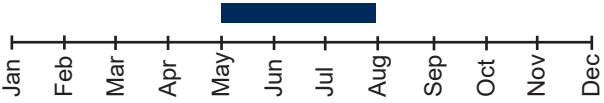
Herbicide damage occurs when a broadleaf herbicide contacts the plant either directly or indirectly via drift, vapor, or herbicide residues in soil, mulch, or compost materials. Symptoms include small misshaped leaves that are thick and tightly curled, stunted growth, and dieback in severe exposure. Plants may recover from minor damage, but yields are typically reduced. Some herbicides that are sprayed during hot temperatures can volatilize with long-distance drift of vapors, while others drift to nearby plants on windy days.

Management

Avoid accidental exposure by following label application directions for temperature, wind speed, correct nozzle size, and spray pressure. Use a hooded sprayer, increase the droplet size, add a spray additive to reduce drift, thoroughly clean sprayers after use, and avoid spraying when winds are blowing toward the crop. Tomato plants that are exposed to small doses of herbicide damage will likely recover. If exposure is determined to be from mulch or compost, then immediately stop using and remove infected compost.

Timing

Herbicide damage can occur at any time during the growing season but is most common during dry, hot, or windy days after herbicides have been applied nearby.



Horn/Nose Development

Description

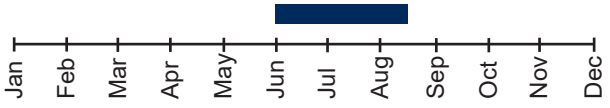
Horn/nose development on tomato fruits is a genetic mutation. It occurs during early fruit development when a few of the cells divide incorrectly, forming an extra fruit locule. Locules are the cavity portion of the fruit surrounded by the pericarp (formed from the wall of the ripened ovary). High temperatures during the night and day can contribute to this mutation. Typically, only one or two fruits are affected on the plant.

Management

Older heirloom varieties of tomatoes tend to be more susceptible. Keeping plants shaded during hot temperatures may help reduce the chance of this mutation. Horn/nose development on the fruit will not affect the taste or quality.

Timing

Horn/nose development starts during fruit development on the plant.



Iron Chlorosis

Description

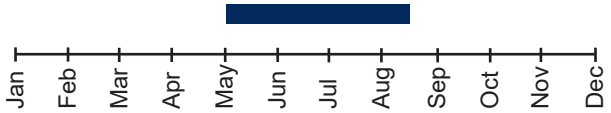
Iron is one of the micronutrients necessary for plant growth and development. It aids in the synthesis of chlorophyll, and it is important for maintaining chloroplast structure and function. In tomatoes, iron deficiency is expressed on foliage with interveinal chlorosis (yellowing of foliage with green veins). Iron has low mobility in the plant, so symptoms will appear first on younger leaves before expanding to the rest of the plant. Due to the lack of chlorophyll, tomatoes struggle to properly photosynthesize. In Utah, where soils are alkaline (pH greater than 7.0), iron chlorosis is common. In high pH soils, iron is fixed to an insoluble form, making it unavailable to plant roots.

Management

Conducting a soil test can identify the pH and availability of iron and other possible nutrient deficiencies. Mitigate iron chlorosis by applying chelated iron fertilizer in the form of EDHHA directly to the soil. Applying foliar iron may also be necessary but is a temporary solution.

Timing

Iron chlorosis can affect plants from transplant to harvest.



Leggy Seedlings

Description

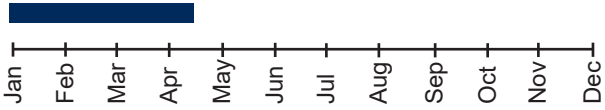
“Legginess” in tomatoes occurs when newly germinated seedlings develop weak stems with long internodes. This happens when there is little to no light available, causing plants to stretch to reach a light source. Eventually, seedlings become spindly, weak-stemmed, and collapse.

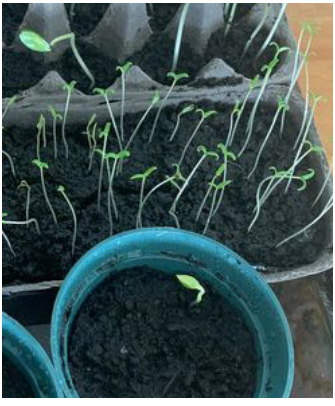
Management

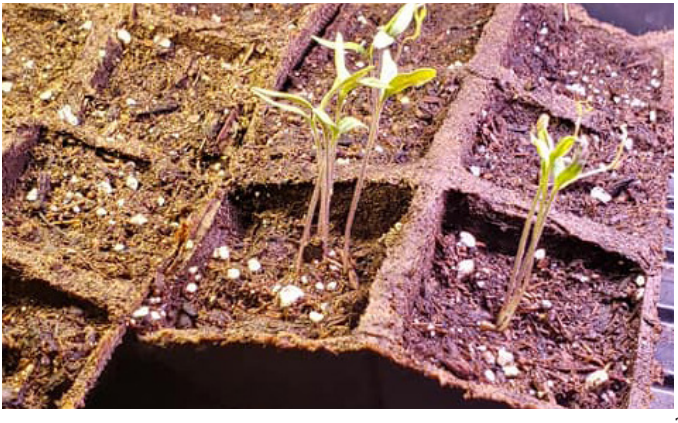
“Legginess” often occurs in winter and early spring when starting seeds too early, especially indoors, During this time the days are shorter, so seedlings planted on windowsills may not receive the optimal duration of sunlight they require. When tomatoes sprout after seeding (typically after 7-10 days), make sure plants have access to a very bright light (south- or west-facing window). Artificial lighting is typically needed and should be placed 3-4 inches above the plantings and run for at least 14-16 hours a day. Reference USU Extension’s Start Your Own Seedlings Indoors fact sheet for more detailed instructions and tips on the topic.

Timing

Legginess occurs indoors when seeds are started too early in the winter and early spring.







Nitrogen Deficiency

Description

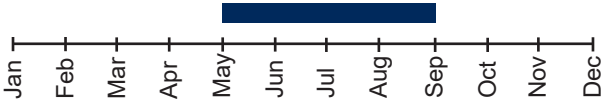
Nitrogen is one of the three macronutrients necessary for plant growth and development. It is a primary component of proteins within plant cells and is most responsible for increasing plant growth. In tomatoes, nitrogen deficiency is expressed by light green to yellow coloration starting on the lower, older foliage that progresses to the rest of the plant. This coloring is due to inhibited chloroplast and chlorophyll synthesis within the plant. Side shoot growth may also be reduced, and eventually, the older foliage will drop.

Management

Conducting a soil test can identify the nitrogen availability in the soil. Nitrogen uptake may also be reduced at low pH (<4). Correct nitrogen deficiency by applying nitrogen fertilizer; different nitrogen forms in fertilizers include nitrate (NO3), ammonia (NH3), ammonium (NH4), or urea (COCNH). Organic fertilizer options are also available. Be sure to review fertilizer labels since nitrogen is very mobile in both the soil and within the plant.

Timing

Nitrogen deficiency can affect plants from transplant to harvest.



Phosphorus Deficiency

Description

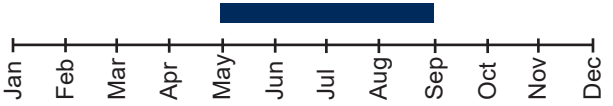
Phosphorus is one of the three macronutrients necessary for plant growth and development. It is a critical component for adenosine triphospate (ATP), an energy unit that forms during photosynthesis. Phosphorus also stimulates root development, stem strength, flower formation, seed production, and overall crop quality. Phosphorus deficiency is expressed by small rigid leaf growth, spindly/erect growth, and a dark green, purplish-red discoloration on the underside of leaves. Phosphorus is difficult for tomatoes to uptake when the soil is cold.

Management

Conducting a soil test can identify phosphorus availability in the soil. With Utah's alkaline and calcareous soils, phosphorus can be difficult to manage. Alleviate deficient soils by using plastic mulch to help warm the soil. Source different fertilizers that contain various rates and forms of phosphorus. Do not over-apply since phosphorus leaches from the soil.

Timing

Phosphorus deficieny can affect plants from transplant to harvest.



Physiological Leaf Roll

Description

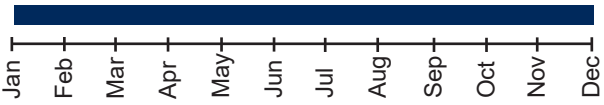
Upward curling or rolling of tomato leaves can be caused by a variety of factors, such as herbicide damage, virus infection, or environmental stresses. Leaf curling or rolling can also be attributed to physiological factors like transplant shock, early planting, root damage from hoeing, severe pruning, drought, heat, an excess or shortage of nutrients, or excessive moisture. Symptoms of leaf curling are the upward cupping of the leaflets toward the mid-vein, and thickened, leathery foliage that remains green. Indeterminate varieties (vining tomatoes) tend to exhibit more physiological leaf roll than determinate varieties (bushing tomatoes). Fortunately, physiological leaf roll tends to have minimal impact on the plant growth and fruit production of tomatoes.

Management

Practices to mitigate physiological leaf roll include selecting less susceptible cultivars, allowing seedlings to properly harden off before transplanting, maintaining consistent soil moisture, avoiding over or under fertilizing, and avoiding excessive pruning.

Timing

Leaf roll can occur on the plant at any point during development, both outdoors and indoors.



Potassium Deficiency

Description

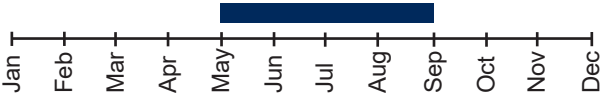
Potassium is one of the three macronutrients necessary for plant growth and development. Potassium assists with water movement and enzyme activation within the plant (affecting proteins, starch, and ATP production). Potassium deficiency in tomatoes is expressed by chlorotic foliage starting on the leaf edges that eventually becomes interveinal (veins remain green). Whitish, necrotic dotsmay also develop among the chlorotic areas. Fruits that are experiencing potassium deficiency may exhibit blotchy, pale coloration along the stem side of the skin.

Management

Conducting a soil test can identify the potassium availability within the soil. Apply as needed.

Timing

Potassium deficieny can affect plants from transplant to harvest.



Storm Damage

Description

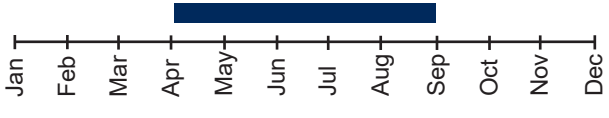
Weather events such as heavy rain, hail, and strong winds can damage vegetable crops, including tomatoes. Strong winds and hail can tear through foliage, removing leaves, and leaving the plant vulnerable to other problems such as sunburn to fruit or reduced photosynthesis. Wind can also snap and break plant stems causing instant death. Heavy rains can wash away soil around the plant affecting the crown and root system. If there is long-term standing water, this prevents roots from absorbing oxygen and may increase the chance of infection by a soilborne pathogen.

Management

Protect tomato plants from storm damage. Secure plants with stakes, apply a covering before a severe storm, and allow appropriate drainage.

Timing

Monitor the forecast during the growing season for risk of severe storms.



Sunscald

Description

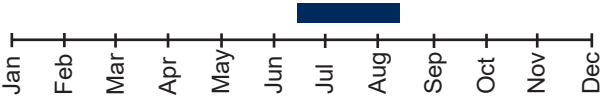
Sunscald occurs on multiple fruit crops when intensive sun light damages the skin. On tomato, it is expressed as white or light-colored, blister-like spots. Eventually the affected areas of the fruit may dry out, become sunken or flattened, and have a paper-like texture. The injury may allow for rot-causing fungi or bacteria to enter. Both green and fully ripened fruit can be affected. Fruits on plants that lose foliage suddenly are especially susceptible.

Management

Prevent sunscald by not pruning in mid-to-late summer. Improve water and nutrient management to allow for healthy foliage growth. Risk of sunscald can increase after harvesting has begun. Therefore, when working amongst tomato plants, take care not to cut or break excessive amounts of vines, leaves, or branches. Shade cloth (30%) can help reduce sun exposure and lower plant temperatures. Reference USU Extension's Using Shade for Fruit and Vegetable Production fact sheet for advanced information regarding this practice.

Timing

Fruits are susceptible during high heat and sun exposure, most often late June to mid-August.



Vivipary

Description

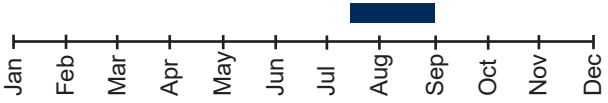
Vivipary occurs when seeds inside a ripe fruit sprout and begin to grow. They appear inside the fruit as white straggly stems with a light green cotyledon. In intact tomatoes, the sprouts eventually poke through the skin of the soon-to-decompose fruit. This happens when the abscisic acid hormone (responsible for controlling seed dormancy) diminishes and the seed germinate while still in the fruit. Other contributing factors could include over-ripening or deficiency or abundance of nutrients. Post-harvest conditions that lead to vivipary are warm temperatures and a humid environment.

Management

Avoid vivipary by storing freshly picked tomatoes face up near an indirect sunlight source. Keep them at room temperature and avoid stacking them in paper or plastic bags. This will allow the fruits to continue ripening properly and develop good flavor and aroma. If desired, sprouts from vivipary could be carefully transplanted to grow a new plant. They will not be a clone of the mother as it came from a plant's seed that was pollinated by another tomato flower, introducing new parent genes into the seed that will produce the new plant.

Timing

Vivipary occurs after harvest.



Zippering

Description

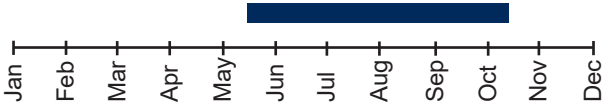
Zippering is the presence of a thin, brown longitudinal scar that can extend from the stem to the blossom end of the fruit, resembling a zipper. This occurs when the flower anther sticks to the developing fruit as it grows. A single fruit may have multiple scars. Sometimes a small open hole may develop next to the scar. Often, zippering is superficial and does not affect overall yields or consumption quality.

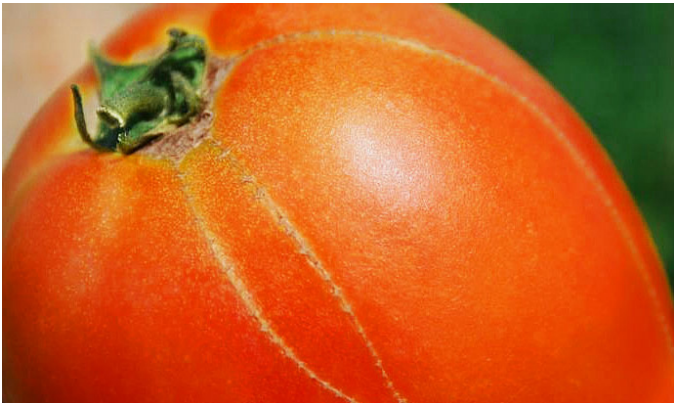
Management

Zippering is theorized to be associated with cool weather and variety genetics. These factors should be considered when aiming to prevent zippering.

Timing

Zippering is present later in the season during fruit formation.





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